

Position of the Academy of Nutrition and Dietetics: Nutrition Security in Developing Nations: Sustainable Food, Water, and Health

ABSTRACT

It is the position of the Academy of Nutrition and Dietetics that all people should have consistent access to an appropriately nutritious diet of food and water, coupled with a sanitary environment, adequate health services, and care that ensure a healthy and active life for all household members. The Academy supports policies, systems, programs, and practices that work with developing nations to achieve nutrition security and self-sufficiency while being environmentally and economically sustainable. For nations to achieve nutrition security, all people must have access to a variety of nutritious foods and potable drinking water; knowledge, resources, and skills for healthy living; prevention, treatment, and care for diseases affecting nutrition status; and safety-net systems during crisis situations, such as natural disasters or deleterious social and political systems. More than 2 billion people are micronutrient deficient; 1.5 billion people are overweight or obese; 870 million people have inadequate food energy intake; and 783 million people lack potable drinking water. Adequate nutrient intake is a concern, independent of weight status. Although this article focuses on nutritional deficiencies in developing nations, global solutions for excesses and deficiencies need to be addressed. In an effort to achieve nutrition security, lifestyles, policies, and systems (eg, food, water, health, energy, education/knowledge, and economic) contributing to sustainable resource use, environmental management, health promotion, economic stability, and positive social environments are required. Food and nutrition practitioners can get involved in promoting and implementing effective and sustainable policies, systems, programs, and practices that support individual, community, and national efforts.

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POSITION STATEMENT

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NUTRITION SECURITY EXISTS when adequate nutrition is achieved. *Nutrition security* is defined as secure access to an appropriately nutritious diet (ie, protein, carbohydrate, fat, vitamins, minerals, and water) coupled with a sanitary environment and adequate health services and care, in order to ensure a healthy and active life for all household members.¹ Nutrition security requires that all people have access to a variety of nutritious foods and potable drinking water; knowledge, resources, and skills for healthy living; prevention, treatment, and care for diseases affecting nutrition status; and safety-net systems during crisis situations, such as natural disasters or deleterious social and political systems.

Food security is a part of nutrition security and exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilization, and stability.² Although nutrition security requires food security, the two terms are sometimes merged into the term *food and nutrition security* to emphasize both food and health requirements (Figure 1).³

Nutrition insecurity refers to deficiencies (eg, underweight and inadequate intake of vitamins and minerals) and excesses (eg, overweight) of nutrients. This position paper focuses on nutrient deficiencies in developing nations and the contributions that food and nutrition practitioners can make toward global solutions.

For information on nutrition security in the United States, refer to the following Academy of Nutrition and Dietetics position papers:

- Food Insecurity in the United States⁴;
- Food and Water Safety⁵;
- Food and Nutrition Professionals Can Implement Practices to Conserve Natural Resources and Support Ecological Sustainability⁶;
- Comprehensive School Nutrition Services⁷;
- Child and Adolescent Nutrition Assistance Programs⁸;
- Promoting and Supporting Breast-feeding⁹; and
- Individual-, Family-, School-, and Community-Based Interventions for Pediatric Overweight.¹⁰

Internationally, the most overarching development agreement is the

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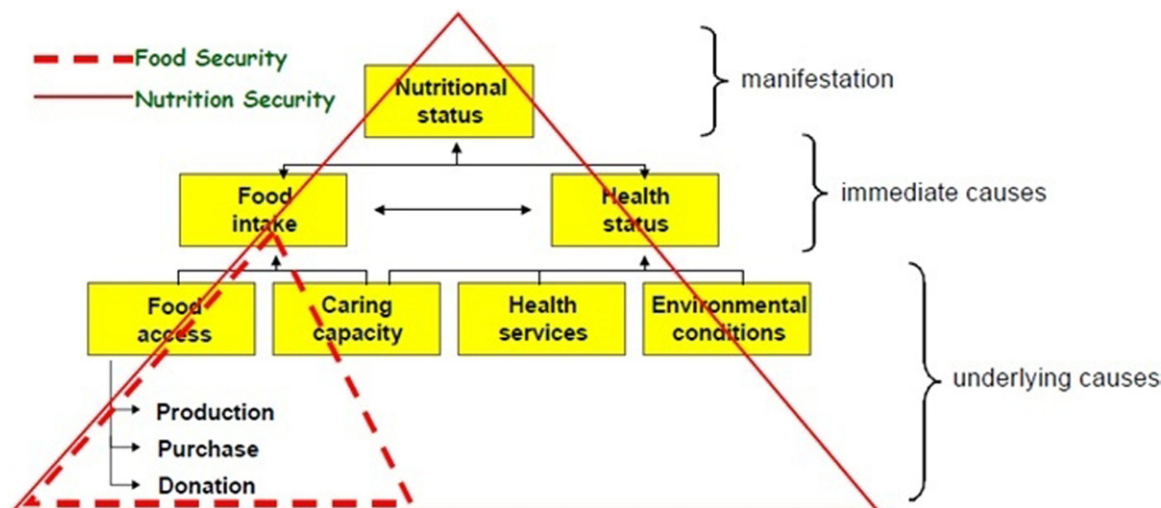


Figure 1. The conceptual framework of nutritional status at the household level. Nutritional status is an outcome of food intake and health status and is linked with causal factors at the household level. The four underlying causes of food intake and health status can be influenced by several determinants. This conceptual framework emphasizes the difference between *food security* and *nutrition security*. Food security, illustrated as the small dotted triangle, refers to the area of causes and effects of food availability at the household level (eg, access to food) and utilization (eg, caring capacity). The underlying causes of health status (environmental causes and health services) can have several contributing factors (eg, poor housing and limited access to health care). Nutrition security, depicted in the large lined triangle, encompasses the entire relationship. Nutrition security exists when adequate nutritional status is achieved. Reprinted with permission from reference 3.

United Nations Millennium Declaration containing 8 Millennium Development Goals.^{11,12} Nutrition security is critical for the achievement of the Millennium Development Goals (Figure 2).

EXTENT OF NUTRITION INSECURITY

Nutrition security is determined using estimates of access to adequate food energy, drinking water, and sanitation; poverty; physical growth; micronutrient status; and morbidity and mortality (Table).^{13–21} Poor sanitation, poverty, and micronutrient deficiencies contribute significantly to the high prevalence of nutrition insecurity, highlighting the importance of addressing diet quality and living conditions. Adequate nutrient intake is a concern, independent of weight status.

Measuring Food Security

Two important limitations with current food security measurements are that the term *food* is generally equated to food energy only, usually from just a few staple foods, failing to measure the wide variety of foods that are needed to provide all the nutrients for an active healthy life; and terms are often used incorrectly and/or interchangeably for *hunger* (a feeling/scarcity of food), *un-*

dernourished (lacking nutrients), *mal-nourished* (poorly nourished), and *food insecurity* (lack of foods needed for a healthy life).

Millennium Development Goal 1 (reducing poverty and hunger) uses the Food and Agricultural Organization's undernourishment estimates as a proxy for hunger, which is equated to the lack of food energy needed for health and does not consider prevalence of malnutrition or the nutritional quality of food.²² Increased awareness of the importance of food diversity has led to a wider variety of foods and nutrients being considered when addressing food security.²² Improved reporting is vital and should incorporate measures of nutritional adequacy.

The Global Hunger Index²³ measures hunger based on the following drivers of hunger: the Food and Agricultural Organization's estimate of people who are food energy-deficient (undernourished); the World Health Organization's prevalence of underweight in children under the age of 5 years; and the United Nations Children's Fund's under-5 mortality rate. This multidimensional approach highlights successes and failures in hunger reduction. Even though progress has been made, the Global Hunger Index remains distressingly high in South Asia and sub-

Saharan Africa. In South Asia, the major contributing factors are low nutrition, poor education, and inferior social status of women. In sub-Saharan Africa, the major contributing factors are low government effectiveness, conflict, political instability, drought, and high rates of human immunodeficiency virus (HIV).

Poverty

The global poverty rate is expected to be reduced to 15% by 2015, achieving the Millennium Development Goal for poverty reduction.¹⁴ Poverty remains largely a rural problem, with approximately 70% (1 billion) of the world's poor living in rural areas.²⁴ Approximately 80% of hungry people are thought to live in rural areas, working as small-scale food producers—farmers, herders, fishers, or laborers—surrounded by the means to produce food and yet they go without.²⁵ The highest proportion of the population lacking access to caloric energy and nutrition security is in sub-Saharan Africa, while Asia has the highest number of people affected. Although progress is being made in reducing poverty, areas suffering from political instability and violence are falling behind in economic growth and human development indicators.¹⁷ Countries with fragile econo-

Millennium Development Goals	
1: Eradicate extreme poverty and hunger	Nutrition security is required to end hunger and contribute to a person's physical and mental capacities, which contribute to development of sustainable livelihoods and poverty elimination.
2: Achieve universal primary education	Optimal learning relies on a healthy body and nutrition security promotes healthy children in healthy environments and maximizes learning capacity.
3: Promote gender equality	Women and girls that have nutrition security are less vulnerable and can focus on improving themselves, their education, their families, and their livelihoods.
4: Reduce child mortality	Nutrition is a foundation for healthy children and is most critical while in the womb and during the first 2 years of life. Malnutrition is linked with more than half of child deaths.
5: Improve maternal health	Mothers who have optimal nutrition with a healthy weight are more likely to have successful pregnancy outcomes.
6: Combat HIV ^a , malaria, and other diseases	Optimal nutrition prevents and treats disease through building the immune system and the body's ability to defend and repair itself. Disease prevention and treatment of helminth infestations and malaria reduces micronutrient deficiencies.
7: Ensure environmental sustainability	Environmental sustainability is required for the provision of healthy food, energy supplies, water, and sanitation.
8: Develop global partnerships	Nutrition security development incorporates health, environment, energy, agriculture, water, sanitation, economics, sex equality, education, and shelter. Global partnerships and unification are critical to success.

Figure 2. The eight United Nations Millennium Development Goals and their link to nutrition security. Visit www.un.org/millenniumgoals for details and status of each goal. ^aHIV=human immunodeficiency virus.

mies and those affected by conflict have yet to achieve a single Millennium Development Goal.¹⁷

The effect of income on nutrition security depends on the local cost of living and social and political systems providing access to land, food, water, housing, health care, and education. Dramatic increases in international food prices have the greatest impact on low-income, food-deficit countries.²⁴ The recent financial, energy, and food crises have negatively affected poor consumers through soaring food prices; reduced household income; and reduced health and social assistance.¹⁶ Lack of dietary diversification aggravates the problem.²⁶ The cause of the food price crisis is not necessarily an underlying shortage in global supply, but a combination of high energy prices, pockets of agricultural failure, the financial crisis, and national policy errors resulting in a general price panic.²⁷ In some countries, there are also increasing demands on the food supply for feeding livestock and making biofuels.¹² Nations are at a higher risk for volatile food prices if their nutrition security is dependent on global financial systems and oil, such as

for producing agrochemicals, operating machinery for harvesting, processing, and transportation.

Nutritional Status

Macronutrients. Globally, approximately 30% of children under 5 years old are stunted and 18% are underweight. As growth slows down, brain development also lags behind and, as a result, stunted children are more likely to learn poorly.¹³ The global prevalence of underweight and stunting in children under age 5 years is decreasing, but prevalence is still unacceptably high in some regions.¹⁶ Approximately 15% of children are born underweight; however, almost 60% of newborns in developing countries are not weighed at birth.²⁸ Access to caloric intake in developing nations has increased during the past 40 years. In 1969–1971, 33% of the population had inadequate access as compared with the current estimation of 16% in 2010.²⁹ Most of Asia is on track to meet Millennium Development Goal 1 (reducing poverty and hunger) but eastern, central, and western Africa are lagging behind.¹⁶

Protein–energy malnutrition (ie, inadequate intake of protein and/or energy over prolonged periods of time) is assessed through measurements and analysis of weight, height, middle upper arm circumference, and age.^{30,31} A child can be too short for their age (stunted*), have low weight for their height (wasted), and/or have low weight for their age (underweight). *Wasting* is an indicator of acute undernutrition, *underweight* is a composite indicator of long-term and current undernutrition, and *stunting* (reduced growth) is an indicator of chronic exposure to nutrient deficiencies and infections. Wasting is the best indicator for determining a child's current nutrition risk because it reflects the present situation, is sensitive to rapid changes, is a good predictor of immediate mortality risk, and can be used to monitor nutritional status changes.

Severe acute malnutrition in children is determined if the weight for height is less than -3 standard deviations, the

**Stunting goes beyond height to impede growth or development.*

Table. Summary of nutrition security statistics in descending order of population prevalence

Approximate % population ^a	Estimation within the 7 billion people on earth ¹³		Reference
36	2.5 billion	Inadequate sanitation	14
30	2+ billion	Lack micronutrients	15
25	1.7 billion	Low urinary iodine	16
	700 million	Goiter (10% of the population)	16
24	1.62 billion	Anemia (from iron/folate/or other health issues)	
		Approximately half of all anemia cases are due to iron deficiency	16
22	1.5 billion	Live in countries affected by repeated cycles of political and criminal violence	17
22	1.4 billion	Consume excess macronutrients (eg, overweight, obese)	18
12	870 million	Inadequate macronutrients (caloric intake is below minimum dietary energy requirement), 98% live in developing nations	1
11	783 million	Lack potable drinking water	14
6.5	456 million	Very poor (live on <US \$1.25 per day)	14
3	216 million	Malaria cases with 655,000 deaths (the majority are children under 5 years of age)	14
3	165 million	26% of children under 5 years of age are stunted (low height-for-age)	19
		>90% of the world's stunted children live in Africa and Asia	20
		Approximately 35% of infants 0 to 6 months old are breastfed exclusively	20
		Approximately one third of breastfed infants 6 to 23 months are provided age-appropriate complementary foods	20
2	163 million	25% of children in developing countries have low serum retinol (low vitamin A status)	16
2	101 million	16% of children under 5 years of age are underweight (low weight-for-age)	19
	19 million	Infants are born underweight annually	21
<1	52 million	8% of children under 5 years of age are wasted (low weight-for-height)	19
<1	43 million	7% of children under 5 years of age are overweight (high weight-for-height)	19
0.5	34 million	HIV ^b -positive with 68% living in sub-Saharan Africa (22.5 million)	
	17.1 million	Children are orphaned from HIV, with almost 90% living in sub-Saharan Africa	14
	7.6 million	Under age 5 child mortality (60 per 1,000 live births)	13

^aApproximate percentage of the population is an estimate calculated by the authors using the World Health Organization's 2011 population with the current data sources, which vary over time. It is only meant to give perspective on the approximate scale of the issues globally.

^bHIV = human immunodeficiency virus.

middle upper arm circumference is <115 mm (an independent risk factor in children ages 6 to 60 months), or if there is bilateral edema.³⁰ The World Health Organization's Anthro program is available online to assess growth status of children and is based on breastfed infants and appropriately fed children from different ethnic origins raised in optimal conditions and measured using standardized techniques.³²

Micronutrients. Micronutrient deficiencies affect more people (36%) than caloric deficiencies (12%), emphasizing the importance of addressing the quality of food in agricultural systems (Table). Micronutrient deficiencies result in fatigue, lethargy, reduced learning ability, brain damage, reduced immunity, miscarriages and other pregnancy complications, blindness, and goiter, and raise the risk for mortality, espe-

cially from diseases such as diarrhea, pneumonia, malaria, and measles.²⁰

The main contributors to micronutrient deficiencies are lack of dietary diversity and incidence of illness and disease.¹⁵ Well-integrated programming with a range of interventions, such as dietary diversification, supplementation, fortification, helminth control, health care access, immunizations, potable water, sanitation, and

hygiene can improve health and save lives.¹⁵

The following five micronutrient deficiencies are of particular concern: iron deficiency, folate deficiency, vitamin A deficiency, zinc deficiency, and iodine deficiency disorder. It is estimated that >1 million children's deaths worldwide could be prevented with adequate vitamin A and zinc and an additional 24,500 deaths prevented with adequate iron and iodine.³³ Adequate micronutrient status improves health and intellectual abilities and the evidence for addressing deficiencies is compelling, cost effective, and achievable.¹⁵

Iron deficiency anemia (IDA) is the most common and widespread nutritional disorder in the world, affecting >25% of the world's population. Iron deficiency is the only micronutrient deficiency prevalent in industrialized countries (Table). It is generally assumed that 50% of anemia cases are due to iron deficiency.³⁴ IDA is frequently exacerbated by infectious diseases, such as malaria, HIV, hookworm infestation, schistosomiasis, and tuberculosis. Eradicating IDA could increase productivity levels by 20%.³⁴ IDA is concentrated in women and preschool-aged children and, if addressed, could reduce mortality substantially.³⁴

Folate deficiency results in anemia and contributes to poor birth outcomes. Inadequate maternal folate intake causes severe birth defects, such as spina bifida and anencephaly. Mothers require adequate folate intake before and during the early stages of pregnancy. Primary preventive measures include a diet rich in folate, and in areas with high deficiencies, the use of supplements containing folic acid and fortified foods.³⁵

The highest prevalence of vitamin A deficiency is found in Africa and Asia, where >40% of preschool-aged children are estimated to be deficient³⁶ and are at risk for night blindness, blindness, and/or death. Promoting dietary diversity with foods rich in vitamin A is a key preventive measure. Where deficiency is widespread, universal vitamin A supplementation twice a year combined with national immunization campaigns has been successful in reducing deficiency symptoms.

It is estimated that zinc deficiency results in about 4% of deaths in children younger than 5 years old.³³ However,

there is little information on prevalence of low serum zinc concentration or inadequate dietary zinc intake. Current estimates rely on the prevalence of stunting among children under 5 years of age.³⁷ Because zinc deficiency is not the only factor affecting children's growth, zinc deficiency prevalence information is required to determine intervention strategies.³⁷ Rigorous evaluations of large-scale dietary approaches are still lacking, but research on zinc treatment has shown positive impacts on reducing diarrhea and acute lower respiratory tract infections, decreasing mortality, and increasing growth velocity in zinc-deficient children.¹⁵ Artificially fertilizing the soil with zinc or adding zinc to crops through breeding are being explored to decrease prevalence of zinc deficiency.³⁸

Iodine deficiency disorder is the greatest single cause of mental retardation and brain damage, with a quarter of the world's population having low urinary iodine.¹⁶ Expanded salt iodization and fortification of other staple items has led to a significant reduction in iodine deficiency disorder public health concerns.³⁹ Currently, 68% of households in developing and industrialized nations are using iodized salt; the goal is 90%. Adding iodine to fertilizer is another initiative to improve food iodine content.⁴⁰ Conversely, a substantial number of countries have high iodine intake levels, putting the population at risk for hyperthyroidism.³⁹ It is essential to monitor iodized salt fortification and utilization practices to ensure programs are safe and effective.

Impact of Nutrition Insecurity on Maternal, Infant, and Child Health

If food and water are limited, pregnant and lactating women, infants, and children are the first to show signs of undernutrition because of their high nutrient needs relative to body size. There is strong evidence that adequate nutrition in utero and up to the first 2 years of life is essential for formation of human capital.⁴¹ Birth weight can be improved by addressing quantity and quality of maternal diet, especially in the prepregnancy period and in the first trimester.¹⁶

Maternal undernutrition increases the risk of maternal mortality during childbirth, leaving children more vul-

nerable to poor health.²⁸ Maternal mortality has been decreasing at a rate of 2.3%, but the rate of decline is not adequate to reach the Millennium Development Goal target.¹¹³ Almost 99% of maternal deaths are in developing nations.¹³ In addition, family planning to reduce family size and increase spacing between pregnancies helps children get the care they need as young children.^{16,42}

The under-5 mortality rate is the single best indicator of children's overall health including nutritional health, health knowledge of mothers, level of immunizations, and availability of prenatal and other health services.²¹ Although child mortality has been declining and is now at 60 deaths per 1,000 live births, many countries are not on track to achieve the Millennium Development Goal.¹¹³ Children suffering from severe acute malnutrition are more than nine times more likely to die than children who are not undernourished.³³ Thirty percent of all deaths among children under 5 years of age are related to undernutrition from stunting, wasting, and micronutrient deficiencies (ie, iron, iodine, vitamin A, and zinc) and, if the effects of suboptimal breastfeeding are also included, an estimated 35% of child deaths are due to undernutrition.³³ The vast majority of child deaths are from preventable and treatable diseases and conditions that can be addressed with sustainable access to food, safe drinking water, health care, basic sanitation, and modern energy sources.¹²

Suboptimal breastfeeding practices and inadequate complementary feeding play a major role in child mortality.³³ Optimal breastfeeding practices, especially exclusive breastfeeding up to 6 months of age, has the single greatest potential impact on child survival, with the potential to prevent 1.4 million deaths in children under 5 years.³³ Breastfed infants are much less likely to die from diarrhea, acute respiratory infections, and other diseases, and are protected from chronic conditions later in life, such as obesity and diabetes.³¹

†Millennium Development Goal: Reduce the maternal mortality ratio by three quarters between 1990 and 2015.

‡Millennium Development Goal: Reduce child mortality by two thirds.

The global rate of early initiation of breastfeeding (within the first hour) is <40% and only 38% of infants in developing countries are breastfed exclusively (ie, no other food, water, or other beverages) for their first 6 months of life.³¹ Ensuring optimal complementary feeding beginning at 6 months of age can prevent 6% of deaths in children under 5 years (about 600,000).⁴² In many countries, only one third of breastfed infants 6 to 23 months of age meet the criteria of dietary diversity and feeding frequency that are appropriate for their age.³¹

Impact of Water, Sanitation, and Hygiene on Nutrition Insecurity

Diarrheal disease affects far more individuals than any other illness.⁴³ Almost one tenth of the global disease burden and 6.3% of all deaths, mainly in developing countries, could be prevented by interventions addressing safe drinking water, sanitation, and hygiene.⁴⁴ Diarrhea is the second leading cause of death among children under 5,⁸ accounting for nearly one in five deaths annually (about 1.5 million deaths), killing more young children than acquired immunodeficiency syndrome, malaria, and measles combined.⁴⁴

The United Nations adopted water as a human right. Although the world is ahead of schedule in meeting the 2015 drinking water target,¹¹ 13% of the population still relies on unimproved water sources (Table).⁴³ Adequate sanitation facilities are lacking for 42% of the population, putting billions at risk for health issues. Improved sanitation facilities combined with hygiene promotion could reduce diarrhea-related deaths in young children by two thirds and accelerate economic and social development.⁴⁵

FACTORS CONTRIBUTING TO NUTRITION SECURITY

This section expands on key issues leading to nutrition security (Figure 1).

§The leading cause of death among children under 5 years of age is pneumonia.

||Millennium Development Goal: Halve, by 2015, the proportion of people unable to reach or afford safe drinking water.

The final section of the paper provides examples of promising practices.

Sustainable Use of Resources[¶]

Sustainability creates and maintains conditions under which humans and nature can exist in productive harmony and fulfills the social, economic, and other requirements of present and future generations.⁴⁶ During the last 50 years, the physical and functional availability of natural resources has shrunk faster than at any other time in history due to increased demand and/or degradation of biodiversity, soil, forests, water, and air.⁴⁷ This has been compounded by a range of factors, including human population growth, changes in lifestyles, and diets that use more land, water, and energy resources.^{25,47} It is imperative to encourage environmentally responsible practices that conserve natural resources, minimize[#] the quantity of waste generated, and support ecological sustainability of the food system.⁶ Individuals can make the biggest single contribution to the environment by shifting to a more environmentally friendly lifestyle.⁴⁸

Up to half of the food produced today is lost, wasted, or discarded as a result of inefficiency.^{49,50} In developing nations, food waste most commonly occurs post-harvest because of poor storage and transport infrastructure. Only an estimated 43% of the cereal produced is available for human consumption, as a result of harvest and post-harvest distribution losses and use of cereal for animal feed.⁵⁰ Zero-waste systems can be designed to maximize production and utilization.⁵⁰

Nearly 3 billion people live in areas where water demand outstrips supply.⁵¹ Expansion in agriculture and manufacturing has increased the demand for water and contributed to surface and ground water pollution.⁵² Signs of severe

environmental degradation because of irrigation, overextraction, and water pollution (eg, from intensive livestock production, pesticides, and fertilizers) are apparent in a growing number of places.⁴⁷ Water will increasingly be a key constraint and improved water management is critical.⁴⁷ Agriculture is the largest user of freshwater resources, which can be as high as 85% of total water withdrawal (used mostly for irrigation) and it is necessary to improve rain-fed and irrigated agriculture water management.⁴⁷

Bold actions are needed to protect, restore, and manage land, soil, and water sustainably to alleviate rural poverty and hunger, ensure long-term food and nutrition security, and build drought resilience.⁵³ Resource utilization combined with environmental protection are required to achieve global nutrition security.

Agricultural Systems

Agriculture contributes to the livelihood of 40% of the world's population with 90% of farmers owning <5 acres.⁴⁷ Agriculture is multifunctional because it produces or contributes to food, medicines, nonfood items, ecological services, livelihoods, social stability, culture, and tradition.⁵⁴ The combination of community-based innovations, local knowledge, and science-based approaches maximize output and sustainability of food and water resources.⁴⁷

Nutrition-oriented agricultural systems are required to ensure that soil, plants, animals, and humans obtain diverse nutrients required for optimal growth and health. Agricultural practices should promote adequate, healthy food while protecting and contributing to environmental sustainability.^{24,55} Ecological agriculture (eco-agriculture) can increase productivity, reduce pressure on land and water, substantially reduce agriculture's carbon footprint, and help decrease poverty by improving water management, soil protection, use of mixed crop and animal systems, and appropriate use of supplemental irrigation.⁵⁶⁻⁶⁰

Genetic simplicity, with a narrow focus on high-energy cereal staples, promotes poor dietary diversity contributing to undernutrition, overnutrition, and non-communicable diseases (NCDs).⁵⁵ When fruits, vegetables, legumes, nuts, animal

¶This section highlights globally relevant issues. For details see Position of the Academy of Nutrition and Dietetics: Food and Nutrition Professionals Can Implement Practices to Conserve Natural Resources and Support Ecological Sustainability.⁶

#It is even possible to eliminate waste by designing zero-waste systems that complement each other so that one system's byproducts are the inputs for another system, mimicking natural systems that produce no waste.

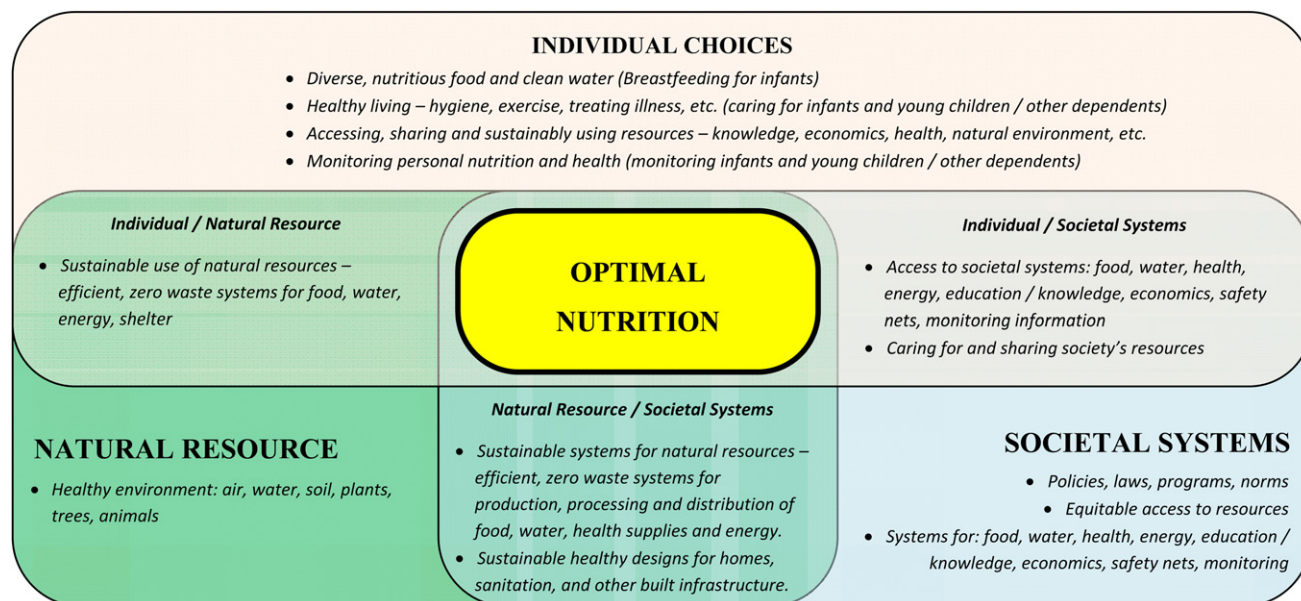


Figure 3. Interactions for achieving optimal nutrition. Optimal nutrition requires Natural Resources, Individual Choices, and Societal Systems. In addition, there is interaction between the three areas in order for optimal nutrition to be achieved.

sources, and other micronutrient-rich foods are displaced by high-carbohydrate staples, energy intake can remain above the minimum requirement, but both macro- and micronutrient intakes are compromised.¹⁶ Single-nutrient intervention strategies have had limited success, resulting in calls for food-based dietary and agricultural diversity approaches.⁵⁵

Of the approximately 30,000 edible plants identified, only 7,000 have been used for human food consumption.^{61,62} Three crops (wheat, rice, and maize) provide more than half of the global plant-derived energy intake and 30 crops provide 95% of caloric energy and/or protein.⁶² An integrated management approach is required to broaden crop diversity and promote nutrition security.⁶³

Biotechnology in the form of genetic engineering, commonly referred to as genetically modified organisms, has produced some crops that are biofortified, chemically resistant, and/or pest resistant. There is no consensus on the benefit or harm of this approach and more research is needed to determine the impact on human and environmental health.^{24,47,63}

The pace of urbanization in the world today is unprecedented, with the fastest rates taking place in the least developed countries.⁶⁴ As people move from rural to urban settings in search of economic opportunities, urban agriculture is becoming an important provider of convenient fresh food and employment options,

while often addressing waste management and reducing transport costs.⁴⁷

Local food systems, local consumption, and domestic outlets for farmers' products can alleviate the risks inherent in international trade.⁴⁷ Investment in local infrastructure, marketing systems, extension and communication services, education, as well as research and development, can increase food supply and improve the functioning of local agricultural markets, resulting in less volatile prices.^{47,65}

HIV, Malaria, and Other Diseases

The high prevalence of HIV, malaria, and other diseases in developing countries interferes with nutrition security by impairing absorption of essential nutrients, increasing nutritional requirements, and decreasing livelihood capacity as a result of sickness, absenteeism, inability to work, and increased time and money spent on treatment and care.¹⁶

Children that have lost parents to HIV are more likely to be malnourished and unschooled.⁵² Early detection and care of HIV, good nutrition, safe drinking water, sanitation and basic health care, appropriate drug therapy, and psychosocial support can help provide a high quality of life and delay progression to acquired immunodeficiency syndrome.

Endemic malaria has a substantial effect on anemia, and anemia is one of many reasons for malaria control.¹⁶ Decreases in malaria cases and deaths re-

sult in steep declines in all-cause deaths among children younger than 5 years of age as a result of decreased prevalence in parasite infestations, severe anemia, and mortality rates.⁶⁶ Forty-two countries are on course to meet the Millennium Development Goal target for reducing malaria.⁵²

NCDs such as cardiovascular disease, diabetes, certain types of cancers, and chronic respiratory diseases are growing steadily, affecting developed and developing nations and people in all age groups.¹³ The causes of NCDs include unhealthy diet, excess energy intake, physical inactivity, overweight and obesity, tobacco use, and excess alcohol. Nutrition transition is characterized by a shift away from a traditional diet toward a more globalized intake pattern that includes increased quantities of processed foods, animal products, sugars, fats, and alcohol.¹⁶ For many countries in nutrition transition, the high rates of food insecurity and undernutrition, combined with increased prevalence of overweight and associated NCDs, have contributed to a "double burden" of malnutrition.¹⁶ Tackling these issues requires healthy food systems, prevention efforts, and access to early detection services.¹³

Gender Equality and Education

Achieving the Millennium Development Goals depends on ensuring

Associations	Web address
American Overseas Dietetic Association	www.EatrightOverseas.org
European Federation of the Association of Dietitians	www.efad.org
International Confederation of Dietetic Associations	www.internationaldietetics.org
International Union of Nutritional Sciences	www.iuns.org
Society for Nutrition Education, Division of International Nutrition Education	www.sne.org
Development: United Nations (UN) and United States (US) nation to nation development	
UN Children's Fund	www.unicef.org
UN Food and Agriculture Organization (FAO)	www.fao.org
UN Millennium Development Goals Indicators	www.unstats.un.org/unsd/mdg/Default.aspx
UN Standing Committee on Nutrition	www.unscn.org
UN Volunteers	www.unv.org
UN World Food Programme	www.wfp.org
UN World Health Organization (WHO)	www.who.int/nutr
US Agency for International Development	www.usaid.gov
US Peace Corps	www.peacecorps.gov
WHO e-Library of Evidence for Nutrition Actions (eLENA)	www.who.int/elena/en/
Development: Nongovernment organizations, research, technical support	
Action Aid	www.actionaid.org
<i>African Journal of Food, Agriculture, Nutrition and Development</i>	www.ajol.info
Africare	www.africare.org
Alive and Thrive (several organizations)	www.aliveandthrive.org
<i>Asia Pacific Journal of Clinical Nutrition</i>	www.healthyeatingclub.com/APJCN/
Bread for the World	www.bread.org
CARE	www.care.org
Catholic Relief Services	www.crs.org
Centre for Science in the Public Interest, International Association of Consumer Food Organizations	www.cspinet.org/reports/codex/iacfosum.html
Church World Service	www.ChurchWorldService.com/Development/
Concern Universal	www.ConcernUniversal.org
Concern Worldwide	www.concern.net
Consultative Group on International Agriculture Research	www.cgjar.org
Development in Gardening	www.developmentsingardening.org
Ecological Sanitation Research Programme	www.ecosanres.org/index.htm
Educational Concerns for Hunger Organization	www.echonet.org
Emmanuel International	www.e-i.org
Evangelical Lutheran Church in America,, World Hunger	www.elca.org
FHI 360, Center for Nutrition	www.aednutritioncenter.org
<i>Food and Nutrition Bulletin</i>	www.inffoundation.org/FNB
Food and Nutrition Technical Assistance Project	www.fantaproject.org
Food for the Hungry International	www.fhi.net
Freedom from Hunger	www.FreedomFromHunger.org
Global Alliance for Improved Nutrition	www.gainhealth.org
Global Horticulture Initiative	www.globalhort.org
Global Service Corps	www.globalservicecorps.org
GOAL	www.goal.ie
Health and Nutrition Tracking Service	www.thehnts.org
Heifer International	www.heifer.org
Helen Keller International	www.hki.org
(continued)	

Figure 4. Organizations and programs involved with nutrition security issues.

equal opportunities for males and females.⁵² Gender roles often prevent females from sharing development benefits equally with men because of

barriers to education, work opportunities, ownership, and unequal representation in the economic and political decision-making process.⁵² At the

household level, individual food distribution is affected by control of income, education, age, birth order, and gender, where women, girls, and

Development: Nongovernment organizations, research, technical support (continued)	Web address
International Baby Food Action Network	www.ibfan.org
International Diabetes Federation	www.idf.org
International Federation of Organic Agriculture Movements	www.ifoam.org
International Food Information Council Foundation	www.foodinsight.org
International Foundation for Organic Agriculture	www.ifoam.org
International Fund for Agricultural Development	www.ifad.org
International Obesity Task Force	www.iotf.org
International Relief and Development	www.ird.org
International Training & Education Center for Health	www.go2itech.org
International Union of Food Science & Technology	www.iufost.org
International Zinc Nutrition Consultative Group	http://www.izincg.org/
Kids Can Make a Difference	www.kidscanmakeadifference.org
La Leche League	www.lalecheleague.com
Linking Information and Decision Making to Improve Food Security (European Commission/FAO)	www.foodsec.org/web
Micronutrient Forum	www.micronutrientforum.org
Micronutrient Initiative	www.micronutrient.org
Oxfam	www.oxfam.org
Plant Resources of Tropical Africa	www.prota.org
ProNutrition	www.pronutrition.org
Save the Children Fund	www.savethechildren.net
Share Our Strength	www.strength.org
Sight and Life	www.sightandlife.org
Slow Food International	www.slowfood.com
Small Planet Institute	www.smallplanet.org
Stockholm International Water Institute	www.siwi.org
The Hunger Project	www.thp.org
Valid International	www.validinternational.org
World Alliance for Breastfeeding Action	www.waba.org.my
World Bank	www.worldbank.org
World Hunger Education Service and Hunger Notes	www.worldhunger.org
World Relief	www.worldrelief.org
World Vision	www.wvi.org
Worldwatch institute, Nourishing the Planet	www.worldwatch.org/nourishingtheplanet
Job postings (also refer to the websites above):	
Development Executive Group	www.devex.com
Development Jobs	www.developmentjobs.org
Eldis	www.eldis.org/news/jobs.htm
Idea List	www.idealists.org
Interaction	www.interaction.org/career-opportunities
International Jobs Center	www.internationaljobs.org
Relief Web	www.reliefweb.int
New Organizing	http://groups.google.com/group/noi-jobs

Figure 4. (continued) Organizations and programs involved with nutrition security issues.

older adults might not have equal access to food.

Women often have the primary role in providing food, water, sanitation, and health care in their communities. Although women have a key role in agricultural activities, they have limited access to and control of resources.⁴⁷ Empowerment of women is essential to raise levels of nutrition security, improve production and distribution of

food and agricultural products, and enhance living conditions.⁶⁷

Projects designed and managed with women's full participation tend to be the most sustainable and effective.⁶⁸ Better-educated women have more opportunities in the labor market and in decision making at all levels, ultimately benefiting the whole community.⁵² Female education is important for making appropriate health decisions and to ex-

pand access to livelihood opportunities. Policies should address female mortality and close gender gaps in access to education, economic, and political opportunities.⁶⁹

Economic Systems: Livelihoods, Markets, and Trade

Rural development is essential to achieving food and nutrition secu-

city.^{24,47} Smallholder agriculture can offer a route out of poverty for many, but only if it is productive, profitable, sustainable, resilient, and well linked to markets.²² Policies and programs must target landless laborers, low-income groups, and other vulnerable food purchasers, therefore promoting livelihood support, job creation, and establishment and strengthening of social assistance programs aimed at improved maternal and child health.¹⁶

Rural areas often have less developed systems for education, health care, economy, social safety nets, and food and water supplies.²⁴ It is essential to improve the overall environment of rural areas (infrastructure, utilities, services, and governance); invest in education to enable women, men, young people, and children to develop the skills they need to take advantage of new economic opportunities; and strengthen the collective capabilities of rural people.²⁴

Access to credit and livelihood assets (eg, land, farming supplies, education, and business start-up costs) is particularly challenging for rural populations. Poor rural households have low, irregular, and uncertain incomes that are often tied to the agricultural seasons, reflecting the household need to achieve more stable incomes.²⁴ Assets are often sold off in order to cope with economic shocks resulting in reduced food stocks, land, and/or farming and household items.

Global Population Aging

Global aging will put increased economic and social demands on all countries. The number of people aged 65 years or older is projected to grow from an estimated 524 million in 2010 to nearly 1.5 billion in 2050, with most of the increase in developing countries.⁷⁰ Because poor nutritional status during pregnancy and infancy influences the development of chronic disease risk factors, many aging individuals are at greater risk for health problems. Smaller family size, increasing urbanization, and fewer extended family households introduce challenges for families in caring for older relatives.⁷⁰ Research is required to determine the global impact of these health risks confronting the aging population and to design appropriate methods for disease prevention. Policies and programs need to be implemented to ensure nutrition security to this population.

FAVORABLE PROGRESS AND PROMISING PROGRAMS

Achieving sustainable nutrition security is the only viable and long-term solution for ending hunger and improving nutrition status,¹⁶ which requires adjustments to individual responsibilities and societies (Figure 3). The following section highlights promising nutrition security approaches and programs. Readers are encouraged to visit the website links for more detail and additional examples (Figure 4).

Nutrition Strategy Solutions

Complementary approaches for reducing undernutrition include direct nutrition-specific interventions and broader multisectoral efforts.⁷¹ Nutrition interventions and practices should be governed by national policy and be integrated into sector policies and programs such as health, agriculture, food security, education, gender equality, environment, habitat, water, sanitation, and energy.⁷¹

Inadequate technical and institutional capacity in monitoring and evaluation, assessing needs, designing and delivering interventions, and providing operational support is a serious constraint in many developing nations. There is a shortage of public health nutritionists including registered dietitians; dietetic technicians, registered; and other qualified personnel at every level. Community nutrition workers are often limited or nonexistent. Agricultural extension workers and health staff receive either basic or no training in nutrition, and typically have weak skills in communicating nutrition information. Building capacity should be a priority.¹⁶

Successful Examples of Practical and Sustainable Nutrition Security Programs

Worldwatch Institute's *Nourishing the Planet: Sustainable Solutions to Hunger and Poverty* (Figure 4) documents hundreds of sustainable solutions to achieve nutrition security. Organizations such as Urban Harvest are working across Africa to enhance urban agricultural efforts. In sub-Saharan Africa, the Educational Concerns for Hunger Organization has helped farmers build gardens using trash to create plant beds. Harvest of Hope helps organize

urban community-supported agriculture programs by purchasing excess produce from city gardens for redistribution to local schools.

Never Ending Food in Malawi teaches how permaculture provides for human needs in sustainable ways through utilization of indigenous resources, integrated organic agriculture, and technologies, such as composting toilets and water harvesting methods. Permaculture design is reported to be a promising development approach for addressing food and nutrition insecurity for orphans and vulnerable children.⁷² Permaculture helps guide communities toward permanent solutions for food and nutrition security, while ensuring that these options exist harmoniously within their environment.

The International Plant Genetic Resources Institute (Figure 4) supports a holistic food-based approach that combines research on traditional foods, investigating options that contribute to better livelihoods, and awareness and promotional campaigns to identify healthful components of traditional diets. National agricultural research centers, universities, and community-based organizations must work together to link biodiversity, nutrition, and health.

Save and Grow⁵⁷ utilizes conservation agriculture, which minimizes tillage, protects the soil surface, and alternates cereals with soil-enriching legumes. These measures save natural resources, time, and money. The Save and Grow farming system is based on proven productivity with economic and environmental benefits.

The Bangladesh Homestead Food Production program⁷³ promotes an integrated package of home gardening, small livestock production, and nutrition education. The program is designed to increase household production, availability, and consumption of micronutrient-rich foods; empower women; enhance partner capacity; increase income; promote community development; and improve the health and nutritional status of women and children.

The Feed the Future (Figure 4) initiative is the US government's global hunger and nutrition security initiative. Feed the Future aims to reduce global hunger and alleviate poverty,

using a country-driven, multisectoral approach. It seeks to increase the incomes of individuals in rural areas who rely on agriculture for their livelihoods by increasing agricultural productivity and improving access to markets.

Village cereal banks help poor households get through the “hungry season,” when food from the last harvest has run out before the next harvest has come in.²⁴ Participating households can obtain cereal loans from the village cereal bank and pay them back after harvest. Cereal banks are credited with improving nutrition, reducing levels of outmigration, increasing agricultural production, and empowering local women and their organizations.

Addressing financial burdens in homes can improve access by household members to adequate food and water supplies. Scarcity of financial institutions in most rural areas has resulted in village savings and loans schemes and microfinance institutions that respond to rural areas working to “graduate” clients into mainstream financial services.²⁴ Conditional cash transfers provide assistance and are conditioned on the beneficiary’s actions, such as enrolling children in school, ensuring regular school attendance and grade completion, and receipt of regular medical attention.¹²

A variety of nutrition supplements are available for those suffering from severe or moderate acute malnutrition through organizations such as Valid International (Figure 4). They include therapeutic infant milk and protein and/or lipid-based spreads, referred to as ready-to-use supplementary foods, ready-to-use therapeutic foods, or food fortifiers. They are fortified with micronutrients and have a base of peanut, other legume or nut, or oilseed (eg, sesame or sunflower), and are designed to meet age-specific needs. They can be used in hospital-, clinic-, community-, or home-based feeding support programs. Ready-to-use supplementary and therapeutic foods can be made locally and are being produced and distributed commercially.

Strategies Addressing Micronutrient Deficiencies

Micronutrient deficiency prevention and control strategies include:

- increased food diversity with improved dietary quality, bioavailability, and quantity;
- disease control;
- improved knowledge and education on prevention and control for policy makers and the general public;
- supplementation to high-risk groups; and
- where deficiencies are high, fortification technologies, such as biofortification, open market fortification of processed food, and targeted fortification.⁷⁴

Sustainable strategies require food-based and non-food-based approaches that incorporate agriculture, health, commerce, industry, education, communication, and local nongovernmental organizations.⁷⁵ A strategic lifecycle approach should include effective public health programs considering the whole reproductive cycle that is complementary and comprehensive across vulnerable periods.⁷⁶ Effective resolutions may differ by population subgroups, region, and country.⁷⁷

Challenges to effective prevention and control strategies include insufficient political priority, lack of resource commitment, inadequate institution and operation capacity, restricted financial access, poor awareness of the magnitude of disease burden, and lack of knowledge and education.⁷⁵ Public resource support of \$10.3 billion a year (United States) is required to begin successfully alleviating undernutrition on a worldwide scale.⁷⁸

Supplementation and fortification address symptoms; the root causes of the problems must still be addressed. Fortification efforts are cost effective and require political support, adequate marketing, and long-term commercial commitment.⁷⁹ When initiating fortification programs, country-specific national decision makers should be responsible for selecting the type and quantity of micronutrients added to foodstuffs based on their country’s situation.⁸⁰ Examples of effective evidence-based micronutrient supplementation interventions include vitamin A supplementation for neonates and children 6 to 59 months, anemia-reduction programs targeted to women and children, and zinc with oral rehydration therapy as

treatment for diarrhea. Micronutrient status should be monitored and used to assess fortification and supplementation requirements and efficacy.⁸⁰

Strategies to Address the First 1,000 Days (Conception to 2 Years)

Organizations have come together to ensure children and families get a healthy start at life through the Framework for Scaling-Up Nutrition: Integrated Maternal and Child Health from conception to 2 years.⁷¹ The program outlines customized country-specific implementation approaches as listed here to improve infant and child nutrition:

1. Promote good nutrition practices:
 - a. breastfeeding (with dietary diversification for mothers before, during, and after pregnancy);
 - b. complementary feeding for infants after the age of 6 months; and
 - c. improved hygiene practices, including hand washing.
2. Targeted provision (World Health Organization guidelines for areas at high risk) of micronutrient supplements for young children and women of childbearing age:
 - a. vitamin A supplements;
 - b. therapeutic zinc supplements for diarrhea management;
 - c. micronutrient powders;
 - d. anti-helminth medications (to reduce losses of nutrients);
 - e. iron-folic acid supplements; and
 - f. iodized oil capsules where iodized salt or other iodized foodstuff is unavailable.
3. Provision of micronutrients through food fortification for nations at high risk. For example:
 - a. salt or other staple food iodization; and
 - b. iron fortification of staple foods.
4. Therapeutic feeding for malnourished children with ready-to-use therapeutic foods:

- a. prevention or treatment for moderate undernutrition;
- b. treatment of severe undernutrition (severe acute malnutrition); and
- c. therapeutic feeding provided at the household, hospital, clinic, or community level with adequate follow-up.

The Infant and Young Child Feeding program ensures a child is protected from under- and overnutrition and their lifelong consequences.⁸¹ Breastfeeding should be initiated within the first hour of birth with exclusive breastfeeding for the first 6 months of life to achieve optimal growth, development, and health. At 6 months, safe and nutritionally adequate complementary foods are introduced while breastfeeding continues up to 2 years of age or beyond.⁸¹ Breastfeeding prevents diarrhea and pneumonia and contributes to improved child spacing. If 90% of infants are reached with a package of interventions to protect, promote, and support optimal Infant and Young Child Feeding practices, overall child mortality could be reduced by approximately one fifth.⁸¹ For mothers known to be HIV-positive, the greatest chance of preventing HIV transmission to the infant is to breastfeed exclusively and receive antiretroviral interventions or avoid all breastfeeding.⁸²

In many countries, poorly funded public health systems lack breastfeeding support services for mothers and families. Deceptively convincing advertising of infant formulas by manufacturers and inappropriate incentives and gifts offered by formula companies to poorly paid health workers for their promotion of breastmilk substitutes contribute to declines in breastfeeding rates. Additional funding is needed to enforce marketing regulations and prosecute violations of the International Code of Marketing of Breastmilk Substitutes. The Baby-Friendly Hospital Initiative³¹ has resulted in substantial global progress in implementing practices that protect, promote, and support breastfeeding. The Baby-Friendly Hospital Initiative encourages and recognizes organizations that become centers of breastfeeding support. Approximately 25% of health

facilities are designated as baby friendly in 154 countries around the world.

Community-based, behavior-centered nutrition education programs are a critical form of outreach in remote and resource-poor contexts. An example is Animadora Plus,¹⁵ which is being utilized in the most food-insecure areas in northern Mozambique. Volunteers are trained to promote nutrition through consumption of a balanced diet, especially during pregnancy, lactation, and early childhood. Micronutrient-rich foods, enriched porridges for infants, and preservation of fruits and vegetables are promoted. As a result, chronic malnutrition in children has decreased considerably.

Strategic research is needed to address the effective prevention and control of micronutrient deficiencies and their consequences in young children living in low-income countries and should include scaling up effective interventions, evaluating cost-effective alternatives, implementing evidence-based practices, and determining physiological processes outlining the risks and benefits of supplementation in children exposed to infectious diseases.⁸³

Strategies Addressing School Health and Nutrition

Schools that integrate health and nutrition into their classrooms and communities can become centers of excellence and hubs of knowledge and practice beyond the school-aged child. School meal programs provide complete or supplemental meals to promote nutrition, school participation, and learning potential. Gardens in schools can spread to communities and increase awareness of the importance of good nutrition and dietary diversity. Integrating health and nutrition education into lessons, meals, and gardening activities promotes healthy habits such as dietary diversity, food and water safety, food processing, nutrient preservation, sanitation, and hygiene.¹⁶

Policies and programs that keep girls in school and prevent under-age marriage decrease intergenerational transmission of malnutrition, low birth weight, and child malnutrition. The PROGRESA program in Mexico

uses cash transfers as an incentive for parents with economic hardships to invest in their children's health and education. Outcome measures include better maternal nutrition and use of prenatal care.

ROLES AND RESPONSIBILITIES OF FOOD AND NUTRITION PRACTITIONERS

Members of the Academy of Nutrition and Dietetics (registered dietitians; dietetic technicians, registered; and other health practitioners) have an important role in achieving global nutrition security whether working domestically or internationally. The tips that follow show how to become involved in promoting global nutrition security:

- Increase awareness of how current world events relate to malnutrition.
 - Promote awareness of global nutrition security issues.
 - Learn about, respect, and understand diverse customs and cultures.
 - Write articles addressing global nutrition security for your local newspapers, state Academy association, political leaders, and nutrition or health promotion newsletters.
 - Encourage support for global and domestic outreach efforts promoting nutrition security.
 - Become actively involved to ensure nutrition security programs support sustainable development.
 - Establish a class on global nutrition security issues.
- Network by joining a professional internationally focused interest group.
 - Join organizations such as: The Overseas Academy of Nutrition and Dietetics; the Hunger and Environmental Nutrition Dietetic Practice Group of the Academy; the American Society of Nutrition's International Nutrition Council; the Society for Nutrition Education and Behavior's International Special Interest Group; the

Society for Nutrition Education and Behavior's International Nutrition Education Division or the American Public Health Association's International Health Section.

- Attend national and international professional meetings that have a strong agenda addressing global nutrition security.
- Become familiar with international food assistance and education programs such as Oxfam America, Heifer International, or Bread for the World.
- Volunteer in local, national, or international humanitarian assistance efforts and medical missions.
- Take a class in global nutrition.
 - Learn more about the ramifications of domestic policy decisions on world food security (eg, trade, food regulations, import and export tariffs, and foreign aid).
 - Learn about the policies, programs, and issues related to nutrition security.
- As the nutrition experts, registered dietitians and dietetic technicians, registered, can provide continuing education seminars to other nutrition and medical professionals.
- Become more "green" as you make personal choices. Personal and national decisions affect our immediate environment and also people and environments in other parts of the world.
 - Teach others how changes in their eating and purchasing practices can reduce consumption of the world's nonrenewable resources.
 - Support sustainable food and water efforts locally and internationally (eg, gardening, water filtering, well construction, fish ponds, and reforestation).
- Learn about organizations and programs involved in issues related to nutrition security (see Figure 4).

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Authors: Stacia M. Nordin, RD (Malawi, Africa); Marie Boyle, PhD, RD (College of Saint Elizabeth, Morristown, NJ); Teresa M. Kemmer, PhD, MSA (South Dakota State University, Brookings, SD).

Reviewers: Sharon Denny, MS, RD (Academy Knowledge Center, Chicago, IL); Laurie Lindsay, RD, LDN (Butler Eagle Newspaper, Butler, PA); American Overseas Dietetic Association (Margie Ferris Morris, MS, RD, Ferris Morris Associates, Limited Liability Company, Falls Church, VA); Esther Myers, PhD, RD, FADA (Academy Research & Strategic Business Development, Chicago, IL); Mary Pat Raimondi, MS, RD (Academy Policy Initiatives & Advocacy, Washington, DC); Infectious Disease Nutrition dietetic practice group (DPG) (Sarah Robertson, RD, Middlesex Cancer Center, Middletown, CT); Healthy Aging DPG (Eleanor D. Schlenker, PhD, RD, Virginia Polytechnic Institute and State University, Blacksburg, VA); Public Health/Community Nutrition DPG (Janell Smith, PhD, MS, RD, Valencia College-Lake Nona Medical Campus, Orlando, FL); Quality Management Committee (Susan Smith, MBA, RD, EcoSure, Honolulu, HI); Lisa Spence, PhD, RD (Academy Research & Strategic Business Development, Chicago, IL); Hunger and Environmental Nutrition DPG (Teri Underwood, MS, RD, CD, Founder, Sustainable Diets, Park City, UT); Sally E. Weerts, PhD, RD, LD/N (Agency for Health Care Administration, Jacksonville, FL).

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